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ABSTRACT

This is one of a series of monographs developed by teachers in schools near Leeds, England. It reports on a 4-year examination of possible levels of attainment in mathematics at all ages of compulsory education. It has been planned according to the age of the pupil, and at three levels corresponding to below average, average, and above average pupils. An introductory chart indicates at what stage in a pupil's career a particular mathematical topic could be introduced, but it does not cover revision or reintroduction of the topic, a matter which is left to the discretion of the teacher. The headings have been chosen to cover the full range of the project and therefore certain topics and vocabulary might not be appropriate in some age groups. In all, 36 stages are outlined, with the topics to be included at each stage presented. An appendix outlines the metric system. (MNS)

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NOTES FOR TEACHERS OF MATHEMATICS

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VOLUME 8

GUIDELINES FOR THE CURRICULUM

LEEDS EDUCATION AUTHORITY

MATHEMATICS CURRICULUM STUDY GROUP

THE JOHN TAYLOR TEACHERS' CENTRE

SE 045 367

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MATHEMATICS: GUIDELINES FOR THE CURRICULUM

INTRODUCTION

In 1976 the Mathematics Curriculum Study Group produced two monographs on the levels of mathematics likely to be attained at transfer from primary to middle schools and middle to high schools ("Notes for Teachers of Mathematics" Volumes 2 and 3).

In 1979 the Curriculum Study Group decided to examine and report on possible levels of attainment in mathematics at other points of transfer between tiers within the Authority. The project was later extended to suggest levels of attainment at all ages of compulsory education. The "Mathematics Content" Working Group was formed in 1979 to work on this project and precisely 50 meetings later, in March 1983, their draft was completed. All previous documents prepared by the various Mathematics Curriculum Study Groups have been studied in preparing this new document.

In the meantime the Cockcroft Report (HMSO 1982) noted that "About half the LEAs in England and Wales have issued mathematics guidelines. These are documents which provide guidance to teachers about the content of the mathematics curriculum... (paragraph 359) ... where LEA guidelines exist, they should be taken into account when preparing a school's scheme of work..." (paragraph 362).

This Leeds document has been planned according to the age of the pupil, and in the later stages, at three levels corresponding to below average, average and above average pupils. It indicates at what stage in a pupil's career a particular mathematical topic could be introduced, but it does not cover revision or reintroduction of the topic, a matter which is left to the discretion of the teacher.

The headings have been chosen to cover the full range of the project and therefore certain topics and vocabulary might not be appropriate in some age groups.

A suggested method of using these guidelines in a school is

1. Establish which year group is to be taught (defined by the age on September 1st at the beginning of the academic year)
2. If these guidelines give different ability levels at that age, decide which ability level to use. If in doubt, start with the bottom 20 to 25% of the year group as below average and the top 20 to 25% as above average. It may be necessary to have less than, or more than three ability levels according to the size of the school.
3. From the age and ability level enter the Table giving "Stages to be Taught". This will give at least preliminary guidelines for the school's mathematics curriculum.
4. Modify the preliminary content and ability levels as appropriate to the school and its resources.
5. In the final guidelines for the school, make cross references to books, games, puzzles, vocabulary, the history of mathematics, revision and reintroduction of topics, definitions etc. The numbering has been chosen to facilitate this cross reference.
6. It is implicit that all the individual items in the guidelines should be used in problem solving situations.

APPENDIX

AGE AT BEGINNING OF ACADEMIC YEAR	CLASS	STAGES TO BE TAUGHT TO PUPILS WITH MATHEMATICAL ABILITY		
		ABOVE AVERAGE	AVERAGE	BELOW AVERAGE
PRIMARY				
4 & 5	Reception & Middle Infants (I1)	AS AVERAGE	1-3	AS AVERAGE
6	Top Infants (I2)		4-5	
7	J1		6-8	
8	J2	9-12	9-11	
MIDDLE				
8 M1	J2	9-12	9-11	AS AVERAGE
9 M2 M1	J3	13-16	12-14	12-13
10 M3 M2	J4	17-19	15-17	14-15
11 M4 M3	S1	20-22	18-20	16-18
12 M4	S2	23-25	21-23	19-21
HIGH				
12	S2	23-25	21-23	19-21
13	S3	26-28	24-26	22-24
14	S4	29-30	27-29	25-28
15	S5	31-33	30-32	29-31

TOPIC 01. SETS AND RELATIONS

01.01.1 Concrete objects. Collecting and sorting. Enclosing the set with a complete ring. No intersecting sets. No subsets.

.2 Pictorial representation of sets. No intersecting sets. No subsets.

TOPIC 02. INTEGERS AND THE FOUR RULES

02.01.1 Counting to 10.

.2 Recognition of numbers to 10, including matching numbers with concrete objects.

TOPIC 03 SHAPE AND SPACE; 3-D

03.01.1 Collection and display of objects from the environment.

.2 Sorting of objects from the environment.

.3 Making shapes and patterns. Shapes with, for example, plasticine or clay. Free modelling, and also the copying of 3-D shapes.

.4 Packing shapes into boxes and nests.

TOPIC 04 VOLUME AND CAPACITY

04.01.1 Non-standard units. Experience of liquids and dry goods within and between containers of various shapes and sizes.

TOPIC 05 SHAPE AND SPACE; 2-D

05.01.1 Sorting.

TOPIC 06 LENGTH

06.01.1 Non-standard units. Comparison and ordering of linear dimensions, including personal measurements.

TOPIC 07 TIME AND SPEED

07.01.1 The names of the days.

TOPIC 08 MONEY

08.01.1 Recognition of coins $\leqslant$ 10p

TOPIC 09 MASS, WEIGHT AND DENSITY

09.01.1 Use of balances. Comparison and ordering of mass in non-standard units, e.g. dried peas.

TOPIC 10 PATTERNS, SEQUENCES AND FLOW DIAGRAMS

10.01.1 Arranging simple action-drawings from random to sequential order e.g. "going to bed"

TOPIC 01 SETS AND RELATIONS

01.02.1 Statements to describe sets. Sets made or drawn to represent statements.

TOPIC 02 INTEGERS AND THE FOUR RULES

02.02.1 Ordinal numbers to 10th.

.2 Counting to 31

TOPIC 05 SHAPE AND SPACE; 2-D

05.02.1 Collection and display of plane shapes.

TOPIC 06 LENGTH

06.02.1 Non-standard units. Natural units, e.g. pace, foot, span.

TOPIC 07 TIME AND SPEED

07.02.1 Recognition of (but not necessarily understanding) special times on a clock face, e.g. lunch-, play-, bed-time.

TOPIC 08 MONEY

08.02.1 One-to-one exchange of coin for articles prices at $\leq$10p

TOPIC 09 MASS, WEIGHT AND DENSITY

09.02.1 Ordering: Heavier and lighter of pairs; lightest and heaviest of threes.

STAGE 3

TOPIC 01 SETS AND RELATIONS

01.03.1 Arrow diagrams to show correspondence between sets. One-to-one correspondence.

TOPIC 02 INTEGERS AND FOUR RULES

02.03.1 Addition to ≤ 10 using concrete objects.

.2 Subtraction using ≤ 10 concrete objects.

.3 Recognition of numbers to 31.

.4 Addition, Commutative Law (not named) with totals ≤ 10, e.g. $3 + 2 = 2 + 3$

.5 Addition as horizontal number sentences with totals ≤ 10, e.g. $3 + 2 = \square$

.6 Subtraction as horizontal number sentences with numbers ≤ 10, e.g. $7 - 2 = \square$

.7 Sharing, with dividends ≤ 10 (Practical work, and not using the division sign in recording)

TOPIC 04 VOLUME AND CAPACITY

04.03.1 Comparison and ordering of vessels of different shapes and sizes using non-standard measures, for example egg cups.

TOPIC 05 SHAPE AND SPACE; 2-D

05.03.1 Sorting and tessellation of shapes.

.2 Making shapes and patterns by drawing.

TOPIC 07 TIME AND SPEED

07.03.1 The names of the months.

.2 The calendar related to birthdays and holidays.

.3 The calendar related to seasons. Seasons and the weather.

TOPIC 08 MONEY

08.03.1 Simple selling and stock-taking involving giving change e.g. sale of biscuits.

TOPIC 11 STATISTICS

11.03.1 Pictorial representation; one variable. Pictogram.

STAGE 4

TOPIC 01 SETS AND RELATIONS

01.04.1 Comparison of the number of elements in sets, (most, more than etc.)

TOPIC 02 INTEGERS AND THE FOUR RULES

02.04.1 Multiplication as repeated addition, to give products ≤ 10.

.2 Factors of numbers ≤ 10.

TOPIC 05 SHAPE AND SPACE, 2-D

05.04.1 Matching against labelled shapes: Recognition of triangle, square and circle.

.2 Symmetry. Examples from the environment, e.g. butterfly, leaves.

TOPIC 06 LENGTH

06.04.1 The need for a standard unit: The metre.

TOPIC 07 TIME AND SPEED

07.04.1 Telling the time on a clock face to a) hours and b) half hours.

TOPIC 08 MONEY

07.04.1 Recognition of 20p, 50p coins.

TOPIC 09 MASS, WEIGHT AND DENSITY.

09.04.1 The need for a standard unit; the gram (e.g. in cookery)

.2 kg, e.g. mass of pupil.

STAGE 5

TOPIC 01 SETS AND RELATIONS

01.05.1 Arrow diagrams to show correspondence between sets. One-to-many and many-to-one correspondence.

TOPIC 02 INTEGERS AND THE FOUR RULES

02.05.1 Ordinal numbers to 31st

.2 Place value, 2-digits.

.3 Counting to 100, forward in 1's from 1.

.4 Addition to 99, without carrying, e.g. 53 + 21 = 74, in both horizontal and vertical display.

.5 Recognition of numbers to 100.

.6 Addition and subtraction as reverse operations, e.g. 5 + 3 = 8, 8 - 5 = 3, 8 - 3 = 5.

0.7 Zero as an element in addition and subtraction, e.g. 7 + 0 = 7
7 - 0 = 7

TOPIC 03 SHAPE AND SPACE; 3D

03.05.1 Making simple models by fastening shapes together, for example, mobiles and Christmas decorations.

TOPIC 04 VOLUME AND CAPACITY

04.05.1 The need for a standard unit: The litre.

TOPIC 05 SHAPE AND SPACE; 2D

05.05.1 Symmetry. Making symmetrical shapes, e.g. ink blots, paper folding.

.2 Outline shapes and patterns with straws, pipe cleaners, goeboard etc.

TOPIC 07 TIME AND SPEED

07.05.1 Telling the time on a clock face to quarter hours.

TOPIC 08 MONEY

08.05.1 Relationships between coins less than £1

.2 Simple shopping activities, not involving change, and with totals $\leq$ 50p.

TOPIC 09 MASS WEIGHT AND DENSITY

09.05.1 Balancing objects against standard units, e.g. how many nails weigh 50g.

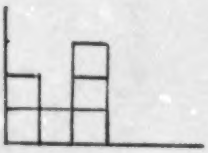
TOPIC 10 PATTERNS, SEQUENCES AND FLOW DIAGRAMS

10.05.1 Arranging random numbers (not greater than 31), words, sentences etc. in sequential order.

TOPIC 11 STATISTICS

11.05.1 Pictorial representation; one variable. Solid column e.g. matchboxes.

.2 Pictorial representation; column chart, vertical axis not numbered.



TOPIC 12 FRACTIONS, DECIMALS, PERCENTAGES, RATIO AND PROPORTION

12.05.1 Fractions; $\frac{1}{4}$ and $\frac{1}{3}$. Recognition, meaning, simple equivalents. simple addition and subtraction (pictorially)

TOPIC 13 AREA AND PERIMETER

13.05.1 Regular shapes in non-standard units to cover an area which may be regular, e.g. a rectangle or irregular, e.g. outline of a foot.

TOPIC 02 INTEGERS AND THE FOUR RULES

0.2.06.1 Multiplication to give products $\leqslant$ 30

.2 Subtraction with totals $\leqslant$ 100 and not involving regrouping, e.g. 87 - 52 = 35

.3 Counting from 20 backwards to 0.

TOPIC 04 VOLUME AND CAPACITY

04.06.1 The litre; applications.

TOPIC 05 SHAPE AND SPACE; 2D

05.06.1 The circle in everyday life, e.g. the wheel.

TOPIC 06 LENGTH

06.06.1 The centimetre.

TOPIC 07 TIME AND SPEED

07.06.1 Use of simple timing devices for elapsed time, e.g. egg-timer, pendulum.

TOPIC 08 MONEY

08.06.1 Relationships between smaller coins and £1.

.2 Recognition of notes and relationships between them.

TOPIC 09 MASS WEIGHT AND DENSITY

09.06.1 Use of various types of balances with standard (metric) units.

TOPIC 10 PATTERNS, SEQUENCES AND FLOW DIAGRAMS

10.06.1 Odd and even numbers.

TOPIC 02 INTEGERS AND THE FOUR RULES

02.07.1 Commutative Law of Multiplication (Law not named) with products 30, e.g. $4 \times 7 = 7 \times 4$

.2 Sharing, with dividends $\leqslant 30$ (Practical work, and not using the division sign in recording)

.3 Place value, 3-digits.

.4 Addition of 2-digit numbers, with carrying, with 3 addends, in vertical display.

.5 2x table known.

TOPIC 03 SHAPE AND SPACE; 3-D

03.07.1 Matching against labelled shapes: Recognition of cube, sphere, cylinder and cone.

TOPIC 06 LENGTH

06.07.1 cm and m: Recording, correct symbols, relation between the two units.

TOPIC 08 MONEY

08.07.1 Addition of pence to give totals $\leqslant$ 100p

.2 Subtraction of pence involving amounts $\leqslant$ 100p.

TOPIC 10 PATTERNS, SEQUENCES, AND FLOW DIAGRAMS

10.07.1 Sequences involving increasing positive integers up to 100.

TOPIC 13 AREA AND PERIMETER

13.07.1 Comparison of areas using non-standard units.

TOPIC 02 INTEGERS AND THE FOUR RULES

02.08.1 Recognition of numbers to 1000

.2 Counting forward in 1's from any number between 100 and 1000.

.3 Addition of 3-digit numbers, with carrying, with $\leqslant$ 3 addends, in vertical display.

.4 Subtraction of 2-digit numbers, in vertical display, with regrouping.

TOPIC 03 SHAPE AND SPACE; 3-D

03.08.1 Matching against labelled shapes: Recognition of cuboid and pyramid (3- and 4- sided bases)

TOPIC 05 SHAPE AND SPACE; 2-D

05.08.1 Making 2-D shapes by folding, cutting or knotting paper.

TOPIC 06 LENGTH

06.08.1 Simple addition and subtraction of cm and m (not mixed)

TOPIC 07 TIME AND SPEED

07.08.1 Elapsed time in standard units (min and hour). How long to perform activities, timed by e.g. stop watch.

TOPIC 08 MONEY

08.08.1 Addition of pence to give totals of more than £1.00, but with the answer given in pence, thus leading to the interchange between pence and pounds.

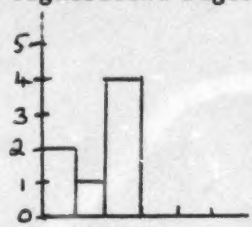
.2 Subtraction of pence involving amounts of more than 100p and working only in pence.

TOPIC 09 MASS WEIGHT AND DENSITY

09.08.1 Addition of g or kg with three addends, two significant figures and no regrouping.

TOPIC 11 STATISTICS

11.08.1 Representation and interpretation of data by vertical bar charts. Numbers representing frequency are placed on lines.



TOPIC 12 FRACTIONS, DECIMALS, PERCENTAGES, RATIO AND PROPORTION

12.08.1 Fractions; $\frac{1}{8}$. Recognition, meaning, simple equivalents, simple addition and subtraction (pictorially)

TOPIC 01 SETS AND RELATIONS

01.09.1 Pictorial and descriptive representation of the empty set and of subsets.

TOPIC 02 FOUR RULES

02.09.1 Zero as an element in multiplication, e.g. 8 x 0 = 0.

.2 Factors of numbers $\leqslant 30$

.3 5x and 10x tables known.

.4 Subtraction of 3-digit numbers, in vertical display, with regrouping, and not having '0' in the centre of the top line.

TOPIC 03 SHAPE AND SPACE; 3-D

03.09.1 Matching against labelled shapes: Recognition of the prism (right triangular prism)

TOPIC 04 VOLUME AND CAPACITY

04.09.1 cm^3; applications.

TOPIC 05 SHAPE AND SPACE 2-D

05.09.1 Shapes with line symmetry, e.g. some capital letters.

.2 Matching against labelled shapes: Recognition of rectangle, kite, rhombus and semi-circle.

TOPIC 06 LENGTH

06.09.1 cm and m, estimating.

TOPIC 07 TIME AND SPEED

07.09.1 Telling the time on a clock face to a) 5 min and b) 1 min.

TOPIC 08 MONEY

08.09.1 Addition of mixed £ and p, with three addends, three significant figures and no regrouping.

TOPIC 09 MASS WEIGHT AND DENSITY

09.09.1 Subtraction of g or kg, two significant figures, no regrouping

TOPIC 11 STATISTICS

11.09.1 Interpretation of horizontal bar charts.

TOPIC 12 FRACTIONS, DECIMALS, PERCENTAGES, RATIO AND PROPORTION

12.09.1 Fractions $\frac{1}{5}$ and $\frac{1}{10}$. Recognition, meaning, simple equivalents, simple addition and subtraction (pictorially)

TOPIC 13 AREA AND PERIMETER

13.09.1 Area conservation; tangrams.

TOPIC 14 GEOMETRY

14.09.1 Recognition of horizontal and vertical.

STAGE 10

TOPIC 01 SETS AND RELATIONS

01.10.1 Pictorial and descriptive representation of the union of two sets, using only disjoint sets, and associated with number statements.

TOPIC 02 INTEGER AND THE FOUR RULES

02.10.1 Place value, 4-digits.

.2 Multiplication to give products 50.

.3 Subtraction of 3-digit numbers, in vertical display, with regrouping, and having '0' in the centre of the top line.

TOPIC 03 SHAPE AND SPACE; 3-D

03.10.1 Recognition and counting vertices, faces and edges.

TOPIC 04 VOLUME AND CAPACITY

04.10.1 ml; applications.

TOPIC 05 SHAPE AND SPACE; 2-D

05.10.1 Matching against labelled shapes: Recognition of parallelogram and hexagon.

TOPIC 08 MONEY

08.10.1 Addition of money, with not more than three addends, not more than four significant figures, with regrouping.

TOPIC 09 MASS, WEIGHT AND DENSITY

09.10.1 Mass: Estimating, measuring and error.

TOPIC 13 AREA AND PERIMETER

13.10.1 Need for a standard unit of area.

.2 Covering a surface with standard squares of 1cm side: Area as measured by cm^2

TOPIC 14 GEOMETRY

14.10.1 Recognition of the right angle: Examples from the environment.

TOPIC 15 INEQUALITIES AND LINEAR PROGRAMMING

15.10.1 Inequalities: Meaning of and

TOPIC 19 NUMBER, STRUCTURE, BASES

19.10.1 Completing simple number sentences, e.g. $3 + \square = 5$

TOPIC 02 INTEGERS AND THE FOUR RULES

02.11.1 Multiplication, 3-digit by 1-digit numbers.

TOPIC 03 SHAPE AND SPACE; 3-D

03.11.1 2-D nets from simple 3-D shapes, for example manufactured containers.

TOPIC 05 SHAPE AND SPACE; 2-D

05.11.1 Tessellations in practice: Tiles, wallpaper, honeycomb etc.

.2 Curve stitching in 2-D

.3 Matching against labelled shapes: Recognition of pentagon.

TOPIC 07 TIME AND SPEED

07.11.1 Recording of date e.g. 20.10.85.

TOPIC 08 MONEY

08.11.1 Further shopping involving making up change to £1 ("counting on")

TOPIC 12 FRACTIONS, DECIMALS, PERCENTAGES, RATIO AND PROPORTION

12.11.1 Fractions; $\frac{1}{3}$, $\frac{1}{6}$ and $\frac{1}{12}$. Recognition, meaning, simple equivalents, simple addition and subtraction (pictorially).

TOPIC 13 AREA AND PERIMETER

13.11.1 Perimeter of simple rectilinear shapes by measuring with a ruler.

TOPIC 14 GEOMETRY

14.11.1 Radius and diameter of a circle.

STAGE 12.

TOPIC 01 SETS AND RELATIONS

01.12.1 Introduction of the notation { }

.2 Listing members of a set.

.3 Describing members of a set.

TOPIC 02 INTEGERS AND THE FOUR RULES

02.12.1 3x and 4x tables known.

.2 Division, 2-digit dividends by 1-digit without remainder, e.g. $91 \div 7$.

.3 Tests of divisibility by 2, 5 and 10.

TOPIC 07 TIME AND SPEED

07.12.1 a.m. and p.m. Meaning and use.

.2 Relations between hours, days, weeks and the year.

.3 Leap years.

STAGE 13

TOPIC 01 SETS AND RELATIONS

01.13.1 Pictorial and descriptive representation of equal sets.

TOPIC 02 INTEGERS AND THE FOUR RULES

02.13.1 Ordinal numbers to 100th.

.2 Multiplication and division as reverse operations, e.g. $3 \times 2 = 6$ and $6 \div 3 = 2$, with reference to the multiplication square and excluding zero.

.3 Additions; examples of the Associative Law, with totals < 99, e.g. $(12 + 10) + 17 = 12 + (10 + 17)$

TOPIC 06 LENGTH

06.13.1 mm, and its relation to cm.

TOPIC 09 MASS, WEIGHT AND DENSITY

09.13.1 Relationship between g and kg.

.2 Addition of mixed mass (kg and g), up to three addends, up to four significant figures.

TOPIC 10 PATTERNS, SEQUENCES AND FLOW DIAGRAMS

10.13.1 Sequences involving increasing positive integers up to 1000.

TOPIC 12 FRACTIONS, DECIMALS, PERCENTAGES, RATIO AND PROPORTION

12.13.1 Fractions: $\frac{1}{7}$ and $\frac{1}{9}$. Recognition, meaning, simple equivalents, simple addition and subtraction (pictorially).

.2 Introduction of terms Numerator and Denominator.

TOPIC 01 SETS AND RELATIONS

01.14.1 Definitions and symbols, $\in$ and $\notin$ meaning is/is not an element (member) of.

TOPIC 02 INTEGERS AND THE FOUR RULES

02.14.1 Associative Law of Multiplication (Law not named), with products $\leqslant 100$. e.g. $(3 \times 4) \times 5 = 3 \times (4 \times 5)$

.2 Division; 2-digit dividends by 1-digit with remainder, e.g. $87 \div 7$.

.3 6x and 8x tables known.

.4 Counting to 100 in 2's or 10's forward from any given start.

TOPIC 06 LENGTH

06.14.1 Multiplication and division of cm and m (not mixed) by integers $\leqslant 10$, without remainder.

TOPIC 08 MONEY

08.14.1 Multiplication of money by integers with products £10 e.g. £2.13 x 3

.2 Division of money by integers $\leqslant 10$, no remainders.

TOPIC 09 MASS WEIGHT AND DENSITY

09.14.1 Mass: Multiplication by integers up to 10

.2 Mass: Division by integers up to 10, with remainders

TOPIC 12 FRACTIONS, DECIMALS, PERCENTAGES, RATIO AND PROPORTION

12.14.1 Fractions; mixed numbers.

TOPIC 13 AREA AND PERIMETER

13.14.1 Perimeter of curved shapes: Practical work involving pacing or using string, tape etc.

.2 Calculation of the perimeter of a given rectangle.

TOPIC 14 GEOMETRY

14.14.1 Two intersecting lines form angles.

TOPIC 01 SETS AND RELATIONS

01.15.1 Intersecting sets.
.2 Venn diagrams

TOPIC 02 Integers and the four rules

02.15.1 Distributive Law (without naming the Law),
e.g. $3 \times 14 = 3 \times (10 + 4) = (3 \times 10) + (3 \times 4)$

.2 Recognition of numbers $\leq 100\,000$.

.3 Place value; 6 digits.

.4 Long multiplication, up to 3-digit numbers by 2-digit numbers.

.5 7x and 9x tables known.

TOPIC 06 LENGTH

06.15.1 The km

TOPIC 07 TIME AND SPEED

07.15.1 Seconds; Use, and relation to minute.

TOPIC 08 MONEY

08.15.1 Addition and subtraction of money involving ½p.

TOPIC 12 FRACTIONS, DECIMALS, PERCENTAGES, RATIO AND PROPORTION

12.15.1 Decimals; notation and place value, tenths and hundreds only.

.2 Decimals; addition involving up to 3 addends and up to 2 decimal places

.3 Decimals; subtraction involving not more than 2 decimal places.

TOPIC 13 AREA AND PERIMETER

13.15.1 Area of rectangle (Length x Width)

TOPIC 14 GEOMETRY

14.15.1 Acute and obtuse angles.

.2 The protractor; angles in degrees.

.3 Introduction to perpendicular and parallel lines.

TOPIC 19 NUMBER, STRUCTURE, BASES

20.15.1 Prefixes used in metric measurements (See Appendix 1)

TOPIC 01 SETS AND RELATIONS

01.16.1 Definitions and symbols, Union $\cup$ and intersection $\cap$

TOPIC 02 INTEGERS AND THE FOUR RULES

02.16.1 Addition of 3- and 4-digit numbers, with carrying, with 5 addends, in vertical display.

.2 Substraction of 4-digit numbers, with regrouping.

TOPIC 05 SHAPE AND SPACE; 2D

05.16.1 Recognition of trapezium and octagon.

TOPIC 06 LENGTH

06.16.1 Relationships between metric units from mm to km inclusive.

07.16.1 Problems involving the addition and subtraction of time.

TOPIC 08 MONEY

08.16.1 Multiplication and division of money involving $\frac{1}{2}$p (no remainders)

TOPIC 10 PATTERNS, SEQUENCES & FLOW DIAGRAMS

10.16.1 Triangle, rectangle and square numbers. (Note that 1 is a triangle number and a square number, but not a rectangle number)

TOPIC 12 FRACTIONS, DECIMALS, PERCENTAGES, RATIOS AND PROPORTION

12.16.1 Decimals; multiplication by integers less than 11.

.2 Decimals; division by integers less than 11 and with examples giving exact answers within two decimal places, e.g. 2·75 ÷ 5 and 2·6 ÷ 4

.3 Decimals; use of zero as a place holder, e.g. 28·21 ÷ 7 and 6·09 ÷ 3

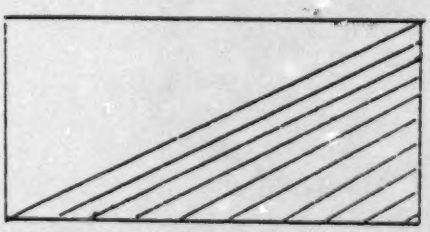
.4 Remainders as fraction of the divisor.

.5 Formal addition and subtraction of proper fractions and mixed numbers having the same denominator.

12.16.6 Changing proper fractions to mixed numbers and vice versa.

TOPIC 13 AREA AND PERIMETER

13.16.1 Area of a right-angled triangle as half the area of the completed rectangle.



TOPIC 14 GEOMETRY

14.16.1 Classification of triangles: scalene, isosceles, equilateral and right angled.

.2 Angle sum of triangle.

TOPIC 16 ERRORS AND APPROXIMATIONS

16.16.1 Rounding off integers to the nearest 10 or 100.

TOPIC 17 CO-ORDINATE GEOMETRY AND CONIC SECTIONS

17.16.1 Simple games, e.g. "Battleships"

.2 Cartesian coordinates: Origin, x- and y- axes, scales.

.3 Cartesian coordinates: Location by coordinates.

STAGE 17

TOPIC 01 SETS AND RELATIONS

01.17.1 Entering elements and interpreting data in two sets in a Venn

TOPIC 02 INTEGERS AND THE FOUR RULES

02.17.1 Long division, 3-digit numbers by 2-digit numbers, with and without remainders.

TOPIC 03 SHAPE AND SPACE; 3-D

03.17.1 Simple 3-D shapes from 2-D nets, including cone and cylinder.

TOPIC 05 SHAPE AND SPACE; 2-D

0.17.1 Use of compasses for circles and circle patterns.

TOPIC 07 TIME AND SPEED

07.17.1 The 24-hour clock.

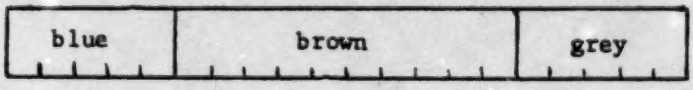
.2 The digital clock.

TOPIC 10 PATTERNS, SEQUENCES, FLOW DIAGRAMS

10.17.1 Prime numbers (Note that 1 is not a prime number)

TOPIC 11 STATISTICS

11.17.1 Compound bar chart; interpretation.



Eye colour of pupils in class.

.2 Pie chart; interpretation.

TOPIC 12 FRACTIONS, DECIMALS, PERCENTAGE, RATIO AND PROPORTION

12.17.1 Decimals; place value to 3 decimal places.

.2 Decimals; multiplication by 10, 100 and 1000.

.3 Decimals; division by 10, 100 and 1000.

.4 Decimals; addition of 3 or more addends with up to 3 decimal places.

.5 Decimals; subtraction with numbers having not more than 3 decimal places.

TOPIC 14 GEOMETRY

14.17.1 Classification of angles; acute, right, obtuse, straight and reflex.

.2 Complimentary and supplementary angles.

TOPIC 15 INEQUALITIES AND LINEAR PROGRAMMING

15.17.1 Inequalities: Meaning of

TOPIC 17 CO-ORDINATE GEOMETRY AND CONIC SECTIONS

17.17.1 Writing Cartesian, coordinates as ordered pairs; positive numbers only.

.2 Plotting points; positive numbers only.

STAGE 18

TOPIC 01 SETS AND RELATIONS

01.18.1 Definitions, finite and infinite sets.

TOPIC 2 INTEGERS AND THE FOUR RULES

02.18.1 11x and 12x tables known.

TOPIC 03 SHAPE AND SPACE 3-D

03.18.1 Recognition of the five regular convex polyhedra; tetrahedron, cube, octahedron, dodecahedron and icosahedron.

TOPIC 05 SHAPE AND SPACE 2-D

05.18.1 Line symmetry.

.2 Rotational symmetry.

TOPIC 07 TIME AND SPEED

07.18.1 Timetables, e.g. class, bus, train, air.

TOPIC 09 MASS, WEIGHT AND DENSITY

09.18.1 Net, gross and tare.

TOPIC 11 STATISTICS

11.18.1 Construction of frequency tables (without grouping).

TOPIC 12 FRACTIONS, DECIMALS, PERCENTAGE, RATIO & PROPORTION

12.18.1 Percentages; introduction "per hundred"

.2 Simple fractions (e.g. tenths and quarters) as percentages.

TOPIC 13 AREA AND PERIMETER

13.18.1 Area of compound rectangular shapes, e.g. L- and T- shapes.

TOPIC 14 GEOMETRY

14.18.1 The circular protractor.

.2 Measuring reflex angles.

TOPIC 15 INEQUALITIES AND LINEAR PROGRAMMING

15.18.1 Inequalities: Meaning of and

TOPIC 17 CO-ORDINATE GEOMETRY AND CONIC SECTIONS

17.18.1 Equations of lines parallel to the x- and y- axis, e.g. $y=2$ or $x=3$.

TOPIC 18 INDICES, POWERS, ROOTS

18.18.1 Squares: Simple numerical examples involving integers only.

TOPIC 19 NUMBERS, STRUCTURE, BASES

19.18.1 The meaning of simple algebraic expressions, e.g. 3b

.2 Substitution of numbers in simple expressions, e.g. 2a + b when a = 3 and b = 4.

TOPIC 20 ALGEBRA (NON-BOOLEAN)

20.18.1 The use of the notation

STAGE 19

TOPIC 01 SETS AND RELATIONS

01.19.1 Definitions and symbols: Universal Set $\mathcal{E}$ (preferably) or E is a subset of $\subset$, is not a subset of $\not\subset$ empty set ϕ (preferably) or empty braces; Venn diagrams incorporating these.

TOPIC 02 INTEGERS AND THE FOUR RULES

02.19.1 Recognition of numbers $>$ 100 000

.2 Tests of divisibility by 3 and 9.

TOPIC 03 SHAPE AND SPACE 3-D

03.19.1 Representation of a cuboid in 2-D

TOPIC 04 VOLUME AND CAPACITY

04.19.1 Volume of cuboid.

TOPIC 06 LENGTH

06.19.1 Addition and subtraction of mixed metric units.

TOPIC 09 MASS, WEIGHT AND DENSITY

09.19.1 Expressing kg and g as kg in decimal form.

TOPIC 12 FRACTIONS, DECIMALS, PERCENTAGE, RATIO AND 'PROPORTION'

12.19.1 Introduction of term "common denominator"

.2 L.C.M.

.3 Formal addition and subtraction of proper fractions and mixed numbers not having the same denominator.

.4 Multiplication of decimal numbers, each with not more than two decimal places.

.5 Multiplication of proper and improper fractions by an integer to give a mixed number.

.6 Multiplication of fractions by fractions.

TOPIC 14 GEOMETRY

14.19.1 Eight points of the compass and the angles between them.

.2 Three-figure bearings.

TOPIC 15 INEQUALITIES AND LINEAR PROGRAMMING

15.19.1 Meaning of $\gg$ and $\ll$

.2 Representation on a number line of simple inequalities, e.g. x 2

TOPIC 16 ERRORS AND APPROXIMATIONS

16.19.1 Estimation of the answers to numerical calculations.

TOPIC 17 CO-ORDINATE GEOMETRY AND CONIC SECTIONS

17.19.1 Introduction to polar co-ordinates.

TOPIC 19 NUMBER, STRUCTURE, BASES

19.19.1 Solutions of simple equations in one unknown and with one operation e.g. $x - 3 = 5$, $2a = 10$.

TOPIC 20 ALGEBRA (NON-BOOLEAN)

20.19.1 The use of symbols to represent operations, e.g. if $a*b = 2a + b$, what is $7*3$?

TOPIC 25 GRAPHS

25.19.1 Polar graph paper.

TOPIC 28 TRANSFORMATION GEOMETRY

28.19.1 Reflection in a given line by accurate drawing.

STAGE 20

TOPIC 02 INTEGERS AND THE FOUR RULES

02.20.1 Relative position of directed numbers, e.g. -3 2, -5 -1.

TOPIC 03 SHAPE AND SPACE 3-D

03.20.1 Observation of Euler's relation, V + F = E + 2 where V, F and E are the numbers of vertices, faces and edges.

TOPIC 05 SHAPE AND SPACE

05.20.1 Scale drawing: Simple scales ($1:10^n$ e.g. 1cm:1m)

TOPIC 09 MASS, WEIGHT AND DENSITY

09.20.1 mg. Relationship with g.

.2 The tonne (t): Relationship with kg.

TOPIC 11 STATISTICS

11.20.1 Arithmetic mean for simple cases, excluding grouped frequencies.

.2 The median.

.3 The mode (modal value).

TOPIC 12 FRACTIONS, DECIMALS, PERCENTAGE, RATIO AND PROPORTION

12.20.1 Division of a fraction by a fraction.

TOPIC 13 AREA AND PERIMETER

13.20.1 Area of non-right angled triangle as $\frac{1}{2}$ (base x perp. height)

TOPIC 14 GEOMETRY

14.20.1 Angle and line properties of quadrilaterals.

TOPIC 16 ERRORS AND APPROXIMATIONS

16.20.1 Numbers correct to either 1 or 2 decimal places.

TOPIC 19 NUMBER, STRUCTURE, BASES

19.20.1 Addition and subtraction of like terms, e.g. 2a + 3a.

TOPIC 20 ALGEBRA (NON-BOOLEAN)

20.20.1 Systems of numeration; Roman, Arabic etc.

TOPIC 23 TOPOLOGY

23.20.1 Introduction, and simple exercises in topological transformations and topological equivalence.

.2 Nodes, arcs and regions.

.3 Observations of Euler's relation N + R = A + 2 where N, R, and A are the numbers of nodes, regions and areas respectively.

TOPIC 06	LENGTH
06.21.1	Multiplication of mm, cm, m and km by integers.
TOPIC 07	TIME AND SPEED
07.21.1	Speed. km per hour.
TOPIC 10	PATTERNS, SEQUENCES, FLOW DIAGRAMS
10.21.1	Sequences involving positive and negative integers.
TOPIC 12	FRACTIONS, DECIMALS, PERCENTAGE, RATIO AND PROPORTION
10.21.1	Conversion between fractions, decimals (including recurring decimals) and percentages.
.2	Finding percentages of given quantities.
.3	Decimals; long division, not more than 3 decimal places in quotient, divided by 2-digit integers.
.4	Division by a decimal having 1 or 2 significant figures.
TOPIC 13	AREA AND PERIMETER
13.21.1	Surface area of cuboid and of triangular prism.
TOPIC 14	GEOMETRY
14.21.1	Congruence
TOPIC 18	INDICES, POWERS, ROOTS
1.8.21	Square roots: simple numerical examples involving integers only.
TOPIC 19	NUMBER, STRUCTURES, BASES
19.21.1	Solution of linear equations (one variable, no fractions, no brackets) e.g. $3x - 1 = 17$
TOPIC 23	TOPOLOGY
23.21.1	Simple closed curves; insides and outsides.
TOPIC 28	TRANSFORMATIONS
28.21.1	Finding mirror lines by accurate drawing.
.2	Simple deductions from line symmetry, e.g. the base angles of an isosceles triangle are equal.

TOPIC 01 SETS AND RELATIONS

01.22.1 Two-ring Venn diagram used for problem solving.

TOPIC 02 INTEGERS AND THE FOUR RULES.

02.22.1 Addition of directed numbers.

.2 Subtraction of directed numbers.

TOPIC 06 LENGTH

06.22.1 Division of mm, cm, m and im by integers.

TOPIC 10 PATTERNS, SEQUENCES, FLOW DIAGRAMS

10.22.1 Flow charts; descriptive, without loops or branches.

.2 Flow charts; symbols for start and stop and action

TOPIC 11 STATISTICS

11.22.1 Representation; simple line graphs of two variables, e.g. recording temperature.

TOPIC 12 FRACTIONS, DECIMALS, PERCENTAGE RATIO AND PROPORTION

12.22.1 Ratio and proportion. Comparisons, 3:2 = n:4, n = ?

.2 Sharing a quantity in given ratios.

.3 Direct proportion, two variables.

.4 One quantity as a fraction or as a percentage of another.

TOPIC 13 AREA AND PERIMETER

13.22.1 Area of compound rectangular and triangular figures, e.g. parallelogram and trapezium.

TOPIC 14 GEOMETRY

14.22.1 Similarity. Similar triangles.

TOPIC 15 INEQUALITIES AND LINEAR PROGRAMMING

15.22.1 Regions bounded by a line parallel to the x- or y- axis, e.g. y 2

TO[illegible] 19 NUMBER, STRUCTURE, BASES

19.22.1 Multiplication of simple terms to given powers 2, e.g. 3a x 2b, 3a x 2a.

TOPIC 20 ALGEBRA (NON-BOOLEAN)

20.22.1 Introduction to bases other than 10.

.2 Bases less than 10; conversion to and from base 10.

TOPIC 23 TOPOLOGY

23.22.1 The order of a node. Odd- and even-ordered nodes.

.2 The condition for constructability of a network.

.3 The condition for traversability of a network. (The Koenigsberg Bridges problem as an illustration)

TOPIC 24	VECTORS
24.22.1	Introduction to vectors as displacements from one point to another, and introduction to the notation $\vec{AB}$
.2	Use of column vectors.
.3	Equal vectors.
TOPIC 28	TRANSFORMATIONS
28.22.1	Practical methods for rotation about a point through $90n^{\circ}$

TOPIC 01	SETS AND RELATIONS
01.23.1	Punched cards for sorting.
TOPIC 11	STATISTICS
11.23.1	Construction of compound bar chart.
.2	Construction of simple pie charts.
TOPIC 12	FRACTIONS, DECIMALS, PERCENTAGE, RATIO AND PROPORTION
12.23.1	Percentage increase or decrease.
TOPIC 13	AREA AND PERIMETER
13.23.1	Practical investigation of the relationship between the diameter and circumference of circles leading to π
TOPIC 14	GEOMETRY
14.23.1	Circle terminology; arc, chord, sector and segment.
TOPIC 16	ERRORS AND APPROXIMATIONS
16.23.1	Significant figures.
TOPIC 17	CO-ORDINATE GEOMETRY AND CONIC SECTIONS
17.23.1	Plotting points; extension to negative numbers.
TOPIC 18	INDICES, POWERS AND ROOTS
18.23.1	Introduction to indices, including squares and 2^5, 3^3 and 4^3.
TOPIC 22	PROBABILITY
22.23.1	Simple examples from experiments, single or repeated, with coins, die, cards etc.
TOPIC 24	VECTORS
24.23.1	Addition of column vectors for multi-stage journeys.
TOPIC 25	GRAPHS
25.23.1	Linear graphs of distance against time for journeys at constant speed.
.2	The intersection of two such graphs, e.g. to find the time or position when one person overtakes or meets another.
TOPIC 28	TRANSFORMATIONS
28.23.1	Projection from a centre.

TOPIC 01 SETS AND RELATIONS

01.24.1 Definitions and symbols; has a subset $\supset$

TOPIC 03 SHAPE AND SPACE; 3-D

03.24.1 Recognition of right prisms with various cross sections.

TOPIC 04 VOLUME AND CAPACITY

04.24.1 Volume of a right prism.

TOPIC 05 SHAPE AND SPACE; 2-D

05.24.1 Scale drawing: Scale other than $1:10^n$

TOPIC 06 LENGTH

06.24.1 Imperial units; mile, yard, foot and inch. Relations between yd, ft, in.

.2 Imperial units; approximate metric conversions -
1 inch approximately equal to 25mm
1 yard less than and approximately equal to 1m
1 mile approximately equal to 1·6 km

TOPIC 07 TIME AND SPEED

07.24.1 Speed. Miles per hour.

TOPIC 08 MONEY

08.24.1 Gross rates of pay, basic and overtime rates.

.2 Bills and invoices.

TOPIC 10 PATTERNS, SEQUENCES, FLOW DIAGRAMS

10.24.1 Hexagon numbers (Note that 1 is a hexagon number)

TOPIC 11 STATISTICS

11.24.1 Construction of grouped frequency tables.

.2 Range as a measure of dispersion.

TOPIC 14 GEOMETRY

14.24.1 Parallel lines and a transverse; alternate, corresponding and interior angles.

TOPIC 18 INDICES, POWERS, ROOTS

18.24.1 Standard form for a large number: $A \times 10^n$ where $1 \leq A < 10$ and n is a positive integer.

TOPIC 19 NUMBER, STRUCTURE, BASES.

19.24.1 Simple expansions, e.g. $3(2x - 5)$

.2 Factorisation by common factor.

TOPIC 20 ALGEBRA (NON-BOOLEAN)

20.24.1 Bases other than 10, particularly binary. The four rules.

TOPIC 28 TRANSFORMATIONS

28.24.1 Translation by a given column vector by accurate drawing.

STAGE 25

TOPIC 01	SETS AND RELATIONS
01.25.1	Three-ring Venn diagrams; entering data and interpretation.
TOPIC 02	INTEGERS AND THE FOUR RULES
02.25.1	Multiplication of directed numbers.
.2	Division of directed numbers.
.3	Combination of the four rules as applied to directed numbers.
TOPIC 04	VOLUME AND CAPACITY
04.25.1	Imperial measures of capacity; pints and gallons; 8 pints = 1 gallon
.2	Approximate metric equivalents of pints and gallons.
TOPIC 08	MONEY
08.25.1	Foreign exchange.
.2	Ready-reckoner tables.
TOPIC 09	MASS, WEIGHT AND DENSITY
09.25.1	Imperial measures of mass; stones, lb and oz. 16 oz = 1lb. 14 lb = 1 stone.
.2	Approximate metric equivalents. 1oz approx. equal to 28g 1lb approx. equal to and less than ½kg 1 stone approx. equal to and more than 6kg
TOPIC 10	PATTERNS, SEQUENCES, FLOW DIAGRAMS
10.25.1	Pascal's triangle.
.2	Fibonacci numbers.
TOPIC 11	STATISTICS
11.25.1	Mean of an ungrouped frequency distribution.
.2	Use of arbitrary origin in calculating the mean.
TOPIC 13	AREA AND PERIMETER
13.25.1	Area of circle.
.2	Area of compound shapes of semicircle and rectilinear figures.
TOPIC 14	GEOMETRY
14.25.1	Construction of angle bisector.
.2	Construction of line bisector.
.3	Construction of perpendicular from a line.
.4	Construction of 45°, 60° and 30° angles.
.5	Construction of perpendicular to a line.
TOPIC 17	CO-ORDINATE GEOMETRY AND CONIC SECTIONS
17.25.1	Straight lines from given equations

TOPIC 18	INDICES, POWERS, ROOTS
18.25.1	The Laws of Indices using integral indices.
.2	The zero index, and negative integral indices.
TOPIC 19	NUMBER, STRUCTURE, BASES
19.25.1	Solution of linear equations involving fractions and brackets.
TOPIC 20	ALGEBRA (NON-BOOLEAN)
20.25.1	The Commutative, Associative and Distributive Laws.
TOPIC 21	MATRICES
21.25.1	Introduction to matrices.
TOPIC 23	TOPOLOGY
23.25.1	Further examples: Mobius Strip and Klein Bottle.
TOPIC 27	TRIGONOMETRY
27.25.1	Introduction to the trigonometrical ratios since, cosine and tangent for acute angles.
.2	Calculation of trigonometrical ratios by accurate drawing.
.3	The use of trigonometrical tables to calculate unknown sides of right-angled triangles (excluding the hypoteneuse)
TOPIC 28	TRANSFORMATIONS
28.25.1	Scale factors of enlargements and the significance of positive and fractional scale factors.

STAGE 26

TOPIC 01	SETS AND RELATIONS
01.26.1	Definitions and symbols, the complement A' of a set A
TOPIC 02	INTEGERS AND THE FOUR RULES
02.26.1	Test of divisibility by 11.
TOPIC 04	VOLUME AND CAPACITY
04.26.1	Volume of cylinder
TOPIC 08	MONEY
08.26.1	V.A.T.
.2	Commission
.3	Discount
TOPIC 11	STATISTICS
11.26.1	Quartiles of ungrouped data.
.2	Interquartile range and semi-interquartile range.
TOPIC 13	AREA AND PERIMETER
13.26.1	Area of annulus.
TOPIC 14	GEOMETRY
14.26.1	Pythagoras. Introduction, theorem and converse, easy triplets.
TOPIC 18	INDICES, POWERS, ROOTS
18.26.1	Standard form, where n is a negative integer.
TOPIC 20	ALGEBRA (NON-BOOLEAN)
20.26.1	The use of the notation $\Leftarrow$ and $\Rightarrow$
TOPIC 21	MATRICES
21.26.1	The order of a matrix.
TOPIC 24	VECTORS
24.26.1	Notation $\underline{a}$ and $2\underline{a}$
.2	General addition and subtraction of vectors, including column vectors.
.3	Product of a number and a column vector.
TOPIC 27	TRIGONOMETRY
27.26.1	The inverse use of trigonometrical tables to calculate angles.
.2	The relationships $\cos\theta = \sin(90^\circ - \theta)$ and $\sin\theta = \cos(90^\circ - \theta)$ for acute angles.
.3	The relationship $\tan\theta = \sin\theta/\cos\theta$
TOPIC 28	TRANSFORMATIONS
28.26.1	Rotation about a point through any angle by accurate drawing.
.2	Finding the centre and angle of rotation by accurate drawing and measurement.

TOPIC 29	FUNCTIONS
29.26.1	Definitions of function, domain and range.
.2	Notations; $f:x \longmapsto \ldots\ldots$ and $f(x) = \ldots\ldots$

STAGE 27

TOPIC 01 SETS AND RELATIONS

01.27.1 The notation n(A) for the number of elements in the set A.

TOPIC 03 SHAPE AND SPACE: 3D

03.27.1 Planes of symmetry.

TOPIC 08 MONEY

08.27.1 Percentage profit and loss.

TOPIC 10 PATTERNS, SEQUENCES, FLOWCHARTS

10.27.1 Descriptive flow charts with loops and branches.

.2 Flow charts; symbol for decision.

TOPIC 11 STATISTICS

11.27.1 Median for an ungrouped frequency distribution of a discrete variable.

TOPIC 14 GEOMETRY

14.27.1 Construction of triangle from given data.

TOPIC 15 INEQUALITIES AND LINEAR PROGRAMMING

15.27.1 Solving inequalities in one variable, e.g. $x + 7 \quad 2x + 3$

TOPIC 17 CO-ORDINATE GEOMETRY AND CONIC SECTIONS

17.27.1 Coordinates of the intersection of two straight lines, leading to the solution of simultaneous equations.

TOPIC 18 INDICES, POWERS, ROOTS

18.27.1 Use of tables of squares and square roots.

.2 Use of square root functions on an electronic calculator.

TOPIC 19 NUMBER, STRUCTURE, BASES

19.27.1 Solution of simultaneous linear equations by elimination.

TOPIC 20 ALGEBRA (NON-BOOLEAN)

20.27.1 Bicimals.

TOPIC 21 MATRICES

21.27.1 Addition and subtraction of matrices.

.2 Multiplication of a matrix by a scalar.

TOPIC 24 VECTORS

24.27.1 Applications of vectors leading to simple geometrical conclusions

TOPIC 25 GRAPHS

25.27.1 Graphs of quadratics, and their use for solutions.

TOPIC 26 BOOLEAN ALGEBRA

26.27.1 Elementary logic. Truth tables and simple developments.

TOPIC 28	TRANSFORMATIONS
28.27.1	Orders and angles of rotational symmetry for plane figures.
TOPIC 29	FUNCTIONS
29.27.1	Simple functions illustrated by flow-diagrams.
.2	The hierarchy of operations.
.3	Inverse functions illustrated by reversed flow-diagrams with inverse operations.
.4	Use of inverse functions to solve equations.

STAGE 28

TOPIC 03 SHAPE AND SPACE; 3D

03.28.1 Axes of symmetry and their associated orders of rotational symmetry.

TOPIC 04 VOLUME AND CAPACITY

04.28.1 Relationship between cm^3 litre and m^3

TOPIC 08 MONEY

08.28.1 Simple interest

.2 Stocks and shares

TOPIC 10 PATTERNS, SEQUENCES, FLOWCHARTS

10.28.1 Flow charts; symbol for "takes a new value of", for example , or := equivalent; and symbol for "print"

.2 Use of numerical flow charts.

TOPIC 11 STATISTICS

11.28.1 Mean for a grouped frequency distribution.

.2 Weighted means.

TOPIC 12 FRACTIONS, DECIMALS, PERCENTAGE, RATIO AND PROPORTION

12.28.1 Inverse proportion, two variables.

TOPIC 14 GEOMETRY

14.28.1 Construction of circumscribed and inscribed circles.

TOPIC 15 INEQUALITIES AND LINEAR PROGRAMMING

15.28.1 Graphical representation of linear inequalities in two dimensions e.g. $2x + 3y \quad 6$

TOPIC 16 ERRORS AND APPROXIMATIONS

16.28.1 Limits of accuracy.

TOPIC 17 CO-ORDINATE GEOMETRY AND CONIC SECTIONS

17.28.1 Introduction to polar coordinates.

TOPIC 18 INDICES, POWERS, ROOTS

18.28.1 Logarithms: Introduction and use for multiplication, division, powers and roots (positive characteristics only)

TOPIC 19 NUMBER, STRUCTURE, BASES

19.28.1 Multiplication of factors to give quadratics, e.g. $(x + 2)\ (x + 3)$ or $(a \pm b)^2$

TOPIC 21 MATRICES

21.28.1 Multiplication of a matrix by a matrix

.2 The condition for matrix multiplication (The 'Domino Rule')

.3 Matrix multiplication is not commutative.

TOPIC 22	PROBABILITY
22.28.1	'Tree diagrams' for example to show the possible outcomes from tossing two coins.
TOPIC 23	TOPOLOGY
23.28.1	Construction of a route matrix from a network, and vice-versa.
TOPIC 24	VECTORS
24.28.1	Modulus
TOPIC 26	BOOLEAN ALGEBRA
26.28.1	Simple Boolean algebraic processes in chains of reasoning, or in circuits with series and parallel connections.
TOPIC 28	TRANSFORMATIONS
28.28.1	Simple deductions from rotational symmetry, e.g. the opposite angles of a parallelogram are equal.

TOPIC 07	TIME AND SPEED
07.29.1	Average speed (total distance/total time)
.2	Problems involving mutli-stage journeys.
TOPIC 08	MONEY
08.29.1	Rent and rates.
TOPIC 10	PATTERNS, SEQUENCES, FLOW DIAGRAMS
10.29.1	Construction of numerical flow charts
TOPIC 11	STATISTICS
11.29.1	Cumulative frequency table and graph (curve, polygon).
TOPIC 13	AREA AND PERIMETER
13.29.1	Circle; length of arc
.2	Circle; area of sector.
TOPIC 14	GEOMETRY
14.29.1	Construction of quadrilaterals from given data.
.2	Division of a straight line into n equal parts by construction.
TOPIC 17	CO-ORDINATE GEOMETRY AND CONIC SECTIONS
17.29.1	Gradient and intercept of a straight line.
.2	Interpretation of $y = mx + c$
.3	Finding the equation of a line given one point and the gradient.
TOPIC 18	INDICES, POWERS, ROOTS
18.29.1	Logarithms with negative characteristics.
TOPIC 19	NUMBER, STRUCTURE, BASES
19.29.1	Factorisation of quadratic trinomials.
.2	Factorisation of the difference between two squares.
TOPIC 21	MATRICES
21.29.1	The transpose of a matrix
TOPIC 22	PROBABILITY
22.29.1	Definitions of the terms: trial, outcome, success.
TOPIC 23	TOPOLOGY
23.29.1	Calculation of two- and three- stage route matrices.
TOPIC 24	VECTORS
24.29.1	Position vectors and the convention $\overrightarrow{OA} = \underline{a}$, $\overrightarrow{OB} = \underline{b}$ etc.

TOPIC 28	TRANSFORMATIONS
28.29.1	Two successive reflections in parallel lines produce a translation.
.2	Two successive reflections in intersecting lines produce a rotation.
TOPIC 30	CALCULUS
30.29.1	The gradient of a curve at a given point by estimation from a graph.

TOPIC 04 VOLUME AND CAPACITY

04.30.1 Volume relationships of similar solids.

TOPIC 07 TIME AND SPEED

07.30.1 Conversion of km/h to m/sec and vice versa.

TOPIC 08 MONEY

03.30.1 Compound interest, not using formula, and with no more than four additions of interest.

.2 Hire purchase.

TOPIC 11 STATISTICS

11.30.1 Median, quartiles and percentiles from graphs.

TOPIC 12 FRACTIONS, DECIMALS, PERCENTAGE, RATIO AND PROPORTION

12.30.1 Inverse problems on percentage change.

TOPIC 13 AREA AND PERIMETER

13.30.1 Area relationships of similar figures, $A \propto L^2$

TOPIC 14 GEOMETRY

14.30.1 Easy applications of Pythagoras' theorem in three dimensions.

TOPIC 15 INEQUALITIES AND LINEAR PROGRAMMING

15.30.1 Linear programming applied to simple problems on, e.g., minimising costs or maximising yields.

TOPIC 19 NUMBER, STRUCTURE, BASES

19.30.1 Change of subject in formulae.

TOPIC 20 ALGEBRA (NON-BOOLEAN)

20.30.1 Construction of operation tables for a given operation defined on a given set.

.2 Closure, identity element and inverse elements.

TOPIC 21 MATRICES

21.30.1 Identity matrices.

.2 The determinant of a 2 x 2 matrix.

.3 The inverse of a 2 x 2 matrix and the condition for it to exist.

TOPIC 22 PROBABILITY

22.30.1 Experimental estimates of probability as $\frac{\text{no. of successes}}{\text{total no. of trials}}$

.2 Probability as a limit as the number of trials tends to ∞

.3 Probability as $\frac{\text{no. of possible successful outcomes}}{\text{total no. of possible outcomes}}$ for a single trial in which all the outcomes are equi-probable.

TOPIC 25 GRAPHS

25.30.1 Linear graphs of velocity against time with constant acceleration, including the interpretation of the area under the graph.

.2 Curvilinear graphs of distance against time, including the estimation of velocities by drawing tangents.

TOPIC 28 TRANSFORMATIONS

28.30.1 Simple transformations of the type $\begin{pmatrix} x \\ y \end{pmatrix} \rightarrow M\begin{pmatrix} x \\ y \end{pmatrix}$ where M is a 2 x 2 matrix, including reflections, rotations, stretches, enlargements and shears.

TOPIC 29 FUNCTIONS

29.30.1 Use of inverse functions to obtain inverse formulae, e.g.

$r = \sqrt{A/\pi}$ from $A = \pi r^2$

TOPIC 08 MONEY

03.81.1 Income Tax

.2 Insurance

TOPIC 11 STATISTICS

11.31.1 Frequency polygons

.2 Vertical line graphs

TOPIC 14 GEOMETRY

14.31.1 Circles: basic theorems (as follows) and their converses

Radius and tangent are perpendicular
Equal chords are equidistant from the centre
Angle at the centre is twice that at the circumference
Angles subtended by the same arc are equal
Angle in a semicircle is a right angle
Opposite angles of a cyclic quadrilateral are supplementary

TOPIC 19 NUMBER, STRUCTURE, BASES

19.31.1 Solution of quadratics by factorisation.

TOPIC 20 ALGEBRA (NON-BOOLEAN)

20.31.1 Simple ideas of group structure.

.2 Isomorphism.

TOPIC 22 PROBABILITY

22.31.1 Expected number of successes from repeated trials.

TOPIC 28 TRANSFORMATIONS

28.31.1 Combinations of transformations, using matrices.

TOPIC 08	MONEY
08.32.1	Bank statements.
.2	Compound interest using formula.
TOPIC 11	STATISTICS
11.32.1	Moving (rolling) averages.
TOPIC 12	FRACTIONS, DECIMALS, PERCENTAGE, RATIO AND PROPORTION
12.32.1	Proportion involving 3 variables and both direct and inverse proportions, $A \propto B/C$
.2	The constant of proportionality.
TOPIC 13	AREA AND PERIMETER
13.32.1	Use of the formula for the area of a sphere.
.2	The earth as a sphere, including latitude and longtitude.
TOPIC 14	GEOMETRY
14.32.1	Angle between tangent and chord.
TOPIC 19	NUMBER, STRUCTURE, BASES
19.32.1	The four rules of algebraic fractions.
TOPIC 21	MATRICES
21.32.1	The solution of two simultaneous linear equations using matrices.
TOPIC 22	PROBABILITY
22.32.1	Sample spaces and sample space diagrams.
TOPIC 23	TOPOLOGY
23.32.1	Schlegel
TOPIC 27	TRIGONOMETRY
27.32.1	Calculation of the hypoteneuse of a right-angled triangle using $\sin \theta$ or $\cos \theta$.
.2	Simple problems in three dimensions involving right-angled triangles only.
TOPIC 28	TRANSFORMATIONS
28.32.1	Inverse transformations using matrices.
.2	The area scale factor of a matrix transformation and its relation to the determinant of the matrix.

TOPIC 01	SETS AND RELATIONS
01.33.1	Three-ring Venn diagrams used for problem solving.
TOPIC 04	VOLUME AND CAPACITY
04.33.1	Volumes of pyramids, cones and spheres.
TOPIC 11	STATISTICS
11.33.1	Median for a grouped frequency distribution by calculation.
.2	Mean deviation from the mean and from the median.
TOPIC 12	FRACTIONS, DECIMALS, PERCENTAGE, RATIO AND PROPORTION
12.33.1	Fractions: mised operations (BIMDAS: I = index)
.2	Percentage increase or decrease at compound rates.
TOPIC 14	GEOMETRY
14.33.1	The property PX.XQ = RX.SX for two intersecting chords or secants of a circle.
.2	The property $PX.XQ = XT^2$ for intersecting secant and tangent.
.3	Construction of a tangent to a circle from an external point.
.4	Construction: Division of a straight line in a given ratio.
TOPIC 18	INDICES, POWERS, ROOTS
18.33.1	Use of tables of reciprocals.
.2	Use of the electronic calculator to find reciprocals.
TOPIC 22	PROBABILITY
22.33.1	Dependent and independent events; the addition and multiplication laws.
TOPIC 23	TOPOLOGY
23.33.1	Incidence matrices, their products and their interpretation.
TOPIC 24	VECTORS
24.33.1	The theorem $\overrightarrow{AB} = \underline{b} - \underline{a}$
.2	The theorem $\underline{m} = \frac{1}{2}(\underline{a} + \underline{b})$ where M is the mid-point of AB
TOPIC 27	TRIGONOMETRY
27.33.1	Definitions of sine, cosine and tangent for angles of any magnitude.
.2	Graphs of the three functions for $0^\circ \leqslant \theta \leqslant 360^\circ$
TOPIC 28	TRANSFORMATIONS
28.33.1	The base vectors $\underline{i}$ and $\underline{j}$ and the use of their images in finding the matrix of transformation.

TOPIC 11 STATISTICS

11.34.1 Standard deviation for simple cases, excluding grouped frequencies.

.2 Variance.

TOPIC 13 AREA AND PERIMETER

13.34.1 Approximate methods for areas bounded by curves: mid-ordinate and rectangular rules.

.2 Trapezium rule.

TOPIC 15 INEQUALITIES AND LINEAR PROGRAMMING

15.34.1 Graphical representation of simple non-linear inequalities in two dimensions. e.g. $y \quad x^2 - 3x$

TOPIC 18 INDICES, POWERS, ROOTS

18.34.1 Positive and negative fractional indices.

TOPIC 19 NUMBER, STRUCTURE, BASES

19.34.1 Solving quadratic equations by completing the square.

.2 Derivation of formula for solution of quadratic equations, and significance of $b^2 - 4ac$

TOPIC 22 PROBABILITY

22.34.1 Probability for mutually exclusive events. Venn diagram and $p(A \quad B) = p(A) + p(B) - p(A \quad B)$

TOPIC 23 TOPOLOGY

23.34.1 The dual of a topological network.

TOPIC 24 VECTORS

24.34.1 Graphical treatment of easy cases of the function.

$$Ax^3 + Bx^2 + Cx + D + Ex^{-1} + Fx^{-2}$$

Where not more than three of the coefficients appear.

TOPIC 28 TRANSFORMATIONS

28.34.1 Classification of isometries.

TOPIC 29 FUNCTIONS

29.34.1 Composition of two functions f and g to give fg(x) where $fg(x) = f(g(x))$

.2 Inverse of fg(x) as $g^{-1}f^{-1}(x)$

TOPIC 30 CALCULUS

30.34.1 Differentiation of algebraic functions of the form

$$y = A + Bx + Cx^2 + Dx^3$$

.2 Calculation of the gradient of a curve at a given point from dy/dx

.3 Use of dy/dx to find the point(s) at which the gradient has a specified value.

.4 Finding stationary points and their values.

STAGE 35

TOPIC 10 PATTERNS, SEQUENCES, FLOW DIAGRAMS

10.34.1 Numerical solutions by iterative methods.

TOPIC 11 STATISTICS

11.35.1 Standard deviation of a variable from its frequency distribution.

TOPIC 15 INEQUALITIES AND LINEAR PROGRAMMING

15.35.1 Graphical representation of two inequalities, one linear and the other involving curves, e.g. $xy \leqslant 1$

TOPIC 18 INDICES, POWERS, ROOTS

18.35.1 Theory of logarithms.

TOPIC 19 NUMBER, STRUCTURE, BASES

19.35.1 Solution of quadratic equations by formula

TOPIC 25 GRAPHS

25.35.1 Curvilinear graphs of velocity against time, including the estimation of acceleration by drawing tangents.

.2 Curvilinear graphs of velocity against time, including the estimation of distance travelled from area under the curve.

.3 Graphs of a^x and $\log_a x$, particularly for $a = 2$ and $a = 10$.

TOPIC 27 TRIGONOMETRY

27.35.1 The Sine Rule and the Cosine Rule, and their use in solving triangles.

TOPIC 28 TRANSFORMATIONS

28.35.1 Transformations of the type $\begin{pmatrix} x \\ y \end{pmatrix} \mapsto \mathbf{M} \begin{pmatrix} x \\ y \end{pmatrix} + \begin{pmatrix} a \\ b \end{pmatrix}$ including glide reflections

TOPIC 30 CALCULUS

30.35.1 Integration of algebraic functions of the form $A + Bx + Cx^2$

.2 Finding the equation of a curve given dy/dx and the coordinates of one point on the curve.

.3 The area under a curve by definite integration.

TOPIC 11	STATISTICS
11.36.1	Frequency density and histograms with unequal class intervals.
.2	The Normal Distribution. The use of a simple form of table for the area under the curve.
TOPIC 19	NUMBER, STRUCTURE, BASES
19.36.1	Construction of formulae in cases of direct, inverse, joint and partial variation, e.g. $V \propto L^3$, $f \propto m_1 m_2 / d^2$
TOPIC 28	TRANSFORMATIONS
28.36.1	Algebraic methods for finding invariant points and lines.
TOPIC 30	CALCULUS
30.36.1	Application of differentiation to problems involving displacement velocity and acceleration.
.2	Application of integration to problems involving displacement, velocity and acceleration.

APPENDIX 1

THE METRIC SYSTEM AND S.I. UNITS

In 1960 The General Conference on Weights and Measures decided to adopt as the International System of Units (Systeme International d'Unites) a system based upon the metre, the kilogramme, the second and the ampere.

The system uses the metric prefixes. Full stops are not used and s is never added to indicate a plural.

The metric prefixes that a pupil is likely to meet in school, taking into account the rise of computing in the school curriculum are given in Table A.

TABLE A

PREFIX		FACTOR	
Name	Symbol		
Mega	M	10^6	x 1000 000
kilo	k	10^3	x 1000
hecto *	h	10^2	x 100
deca *	da	10^1	x 10
deci *	d	10^{-1}	x $\frac{1}{10}$
centi *	c	10^{-2}	x $\frac{1}{100}$
milli	m	10^{-3}	x $\frac{1}{1\ 000}$
micro	μ	10^{-6}	x $\frac{1}{1\ 000\ 000}$
nano	n	10^{-9}	x $\frac{1}{1\ 000\ 000\ 000}$
piko	p	10^{-12}	x $\frac{1}{1\ 000\ 000\ 000\ 000}$

* Not S.I. preferred units.

Table B gives the common units and their correct abreviations.

TABLE B

Quantity	Unit	Symbol
Length	1 metre	1 m
Mass	1 kilogramme	1 kg
Time	1 second	1 s
Area	1 square metre	1 m^2
Volume	1 cubic metre	1 m^3
Temperature	1 degree Celsius	1 ^oC

The basic S.I. Unit of mass is the kilogramme (kg).

$$1 \text{ kg} = 1\,000 \text{ g}$$

and $1\,000 \text{ kg} = 1 \text{ tonne}$

The basic S.I. Unit of length is the metre (m).

$$1 \text{ km} = 1\,000 \text{ m}$$

$$1 \text{ mm} = \frac{1}{1\,000} \text{ m}$$

The centimetre (cm), though not a SI preferred sub-unit, is frequently used, and is $\frac{1}{100}$ m, or 10 mm

The Unit of capacity is the litre, i.e. $\frac{1}{1\,000} \text{ m}^3$

A sub-unit frequently used is the millilitre (ml)
which is equivalent to the cubic centimetre (cm^3)